BAE SYSTEMS

Corrosion Prevention of Army Equipment in the 21st Century

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Report Documentation Page

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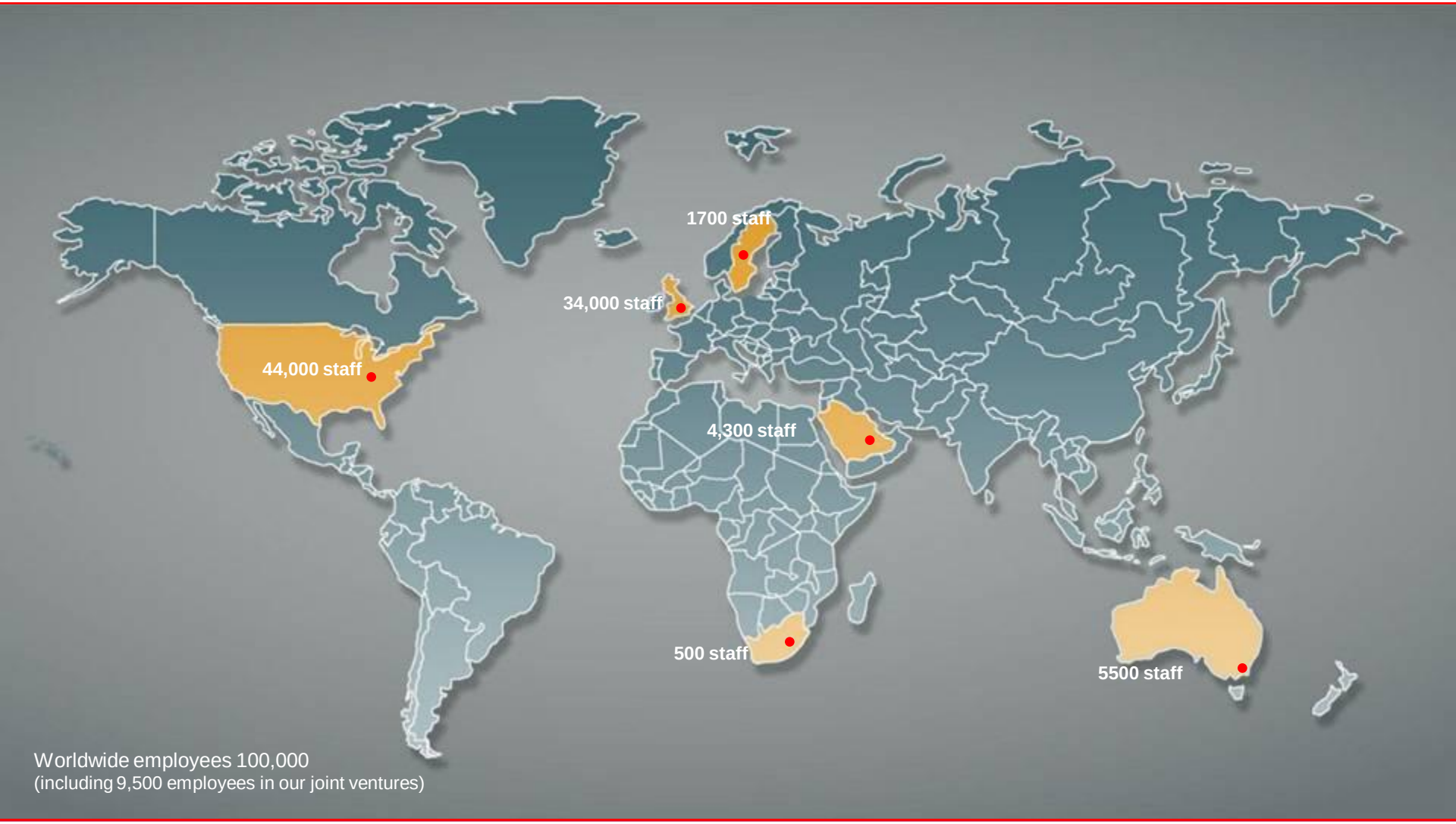
Corrosion Prevention of Army Equipment in the 21st Century

Overview

1. BAE Systems
2. Finding new treatments and coatings
3. Process selection criteria
4. Assessing performance
5. Conclusion

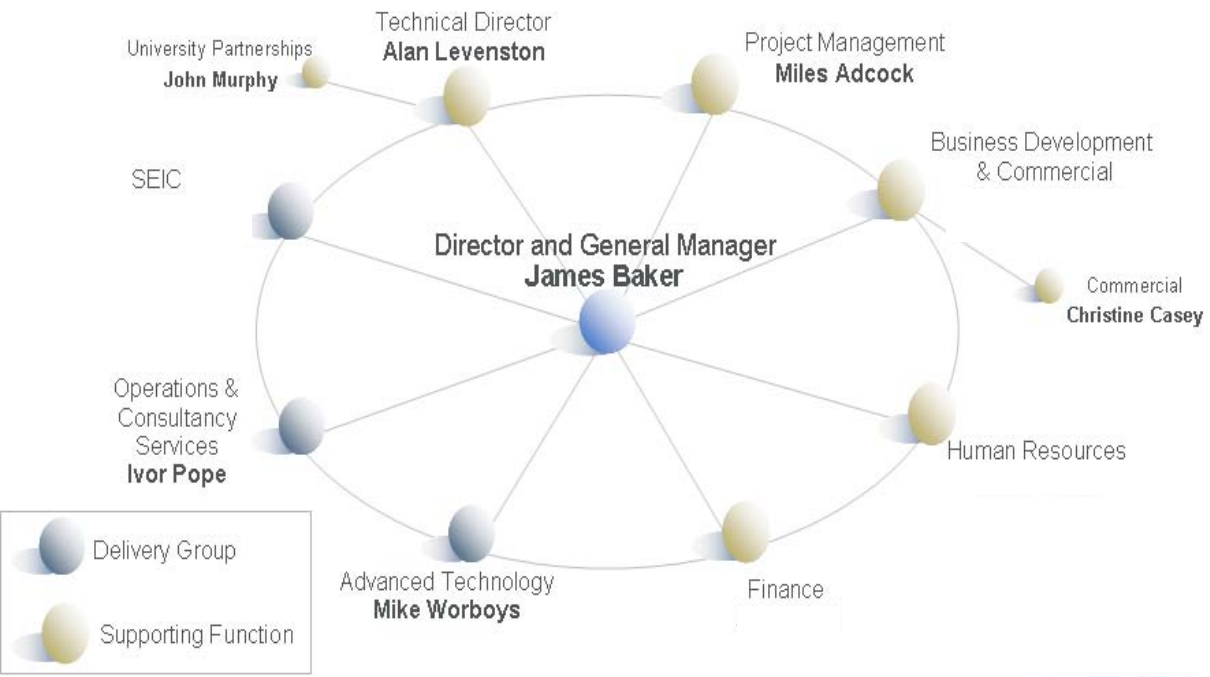
BAE SYSTEMS

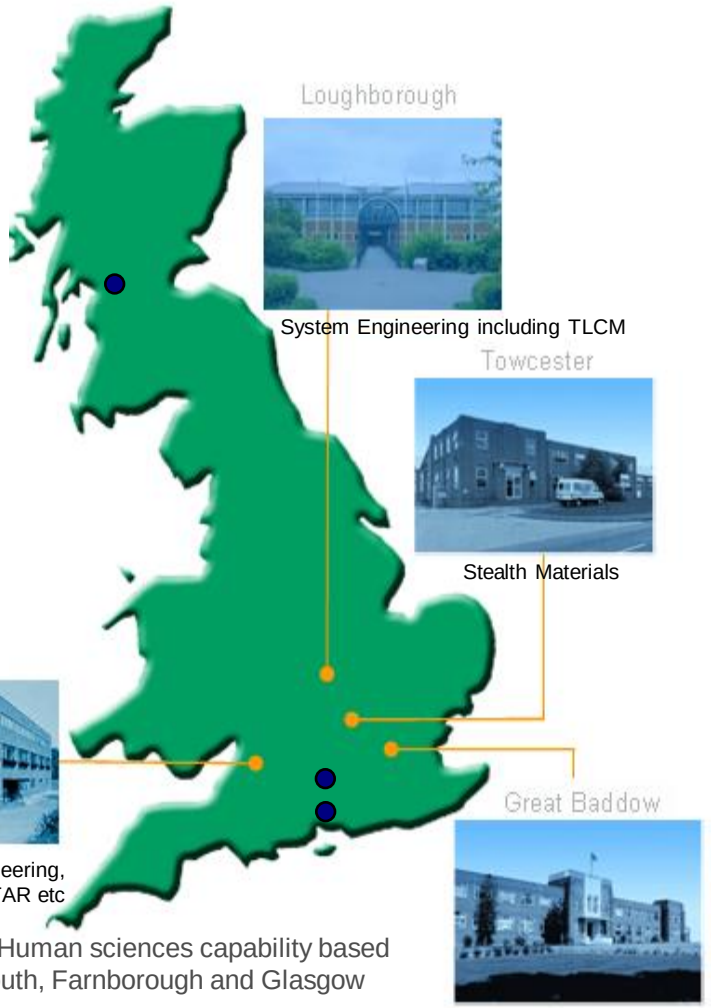
A Global Company with Global Interests



Worldwide employees 100,000
(including 9,500 employees in our joint ventures)

Advanced Technology Centre - Structure and Facilities





ATC

- Turnover: ~ £43M
- Employees: ~ 500

- Employees: >100,000 world wide

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BAE Systems – Delivering Advantage

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2. Finding new treatments & coatings

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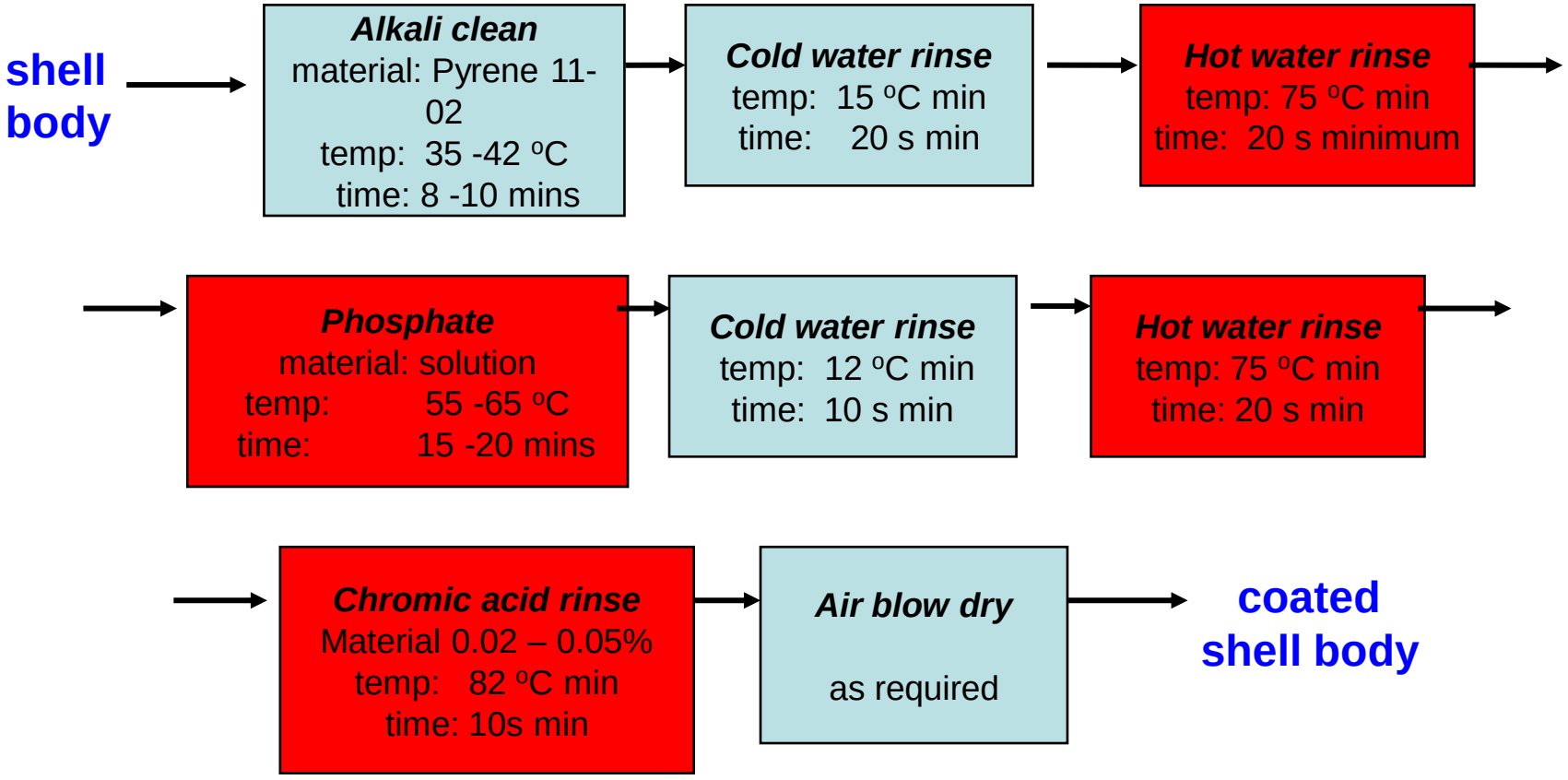
Current surface treatment process



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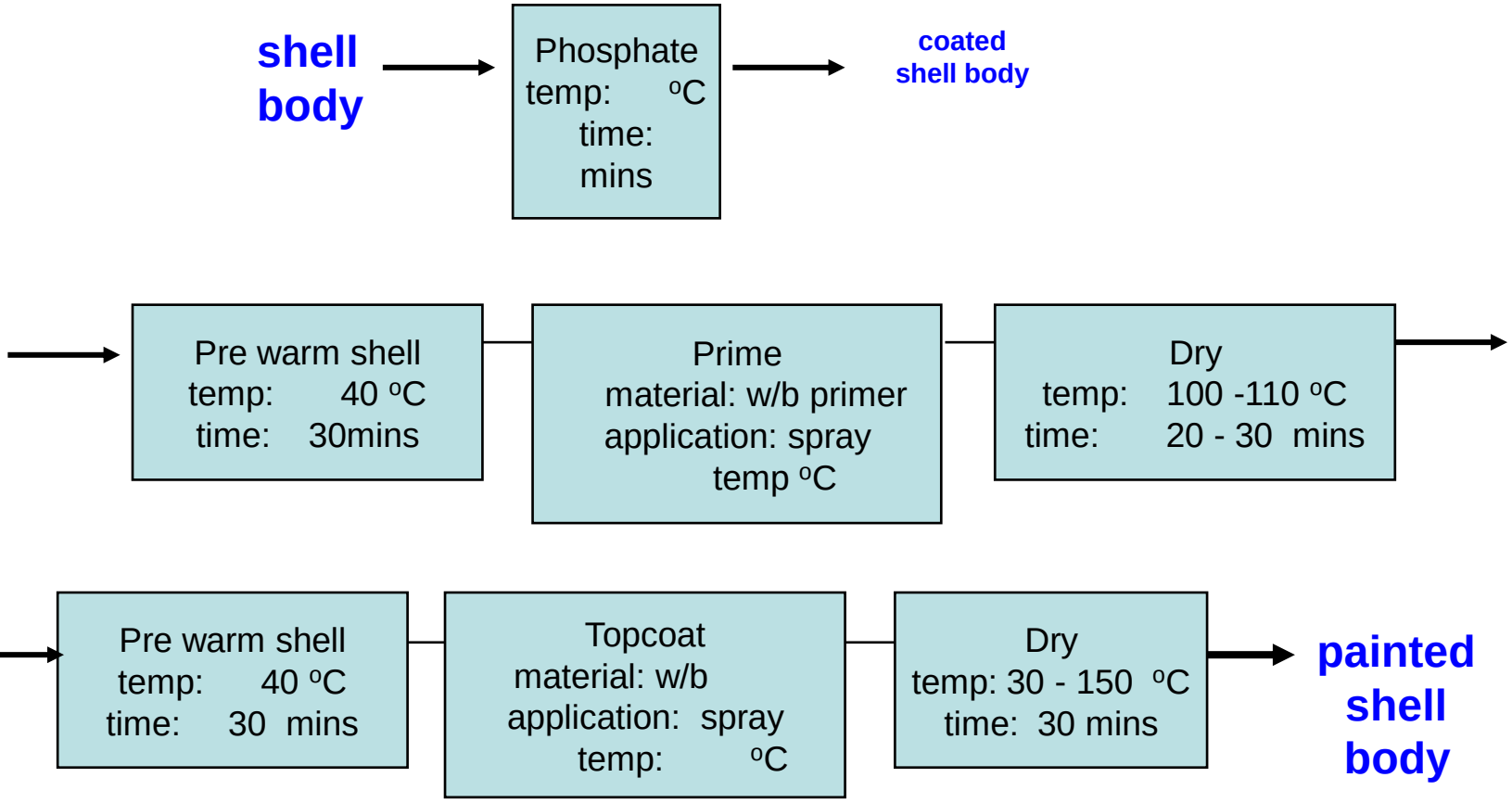
Comparison of Technologies for Surface Treatment

Technology	Process	Tanks	Temperature	Process Time	Chemicals
current	Zn phospate	7	5 heated	30mins	Zn (sludge) chromates
silane	Bespoke	5	Oven dry at 120^{o}C		silane
	Commercial	10	Oven dry		Silane Zr
Zr	1	6	RT		Zr
	2				Zr
	Vanadate	5	RT		Zr,V
Auto catalytic	polymer	7			organic

Current Painting Process



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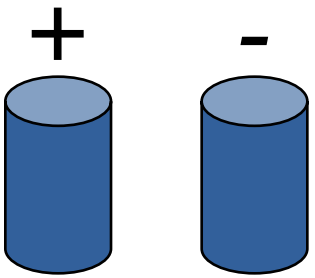
New Coating/Painting Processes

- Current aqueous 2-coat
- New aqueous 2-coat (x3)
- Aqueous single coat (x2)
- Powder coat (x3)
- E-coat



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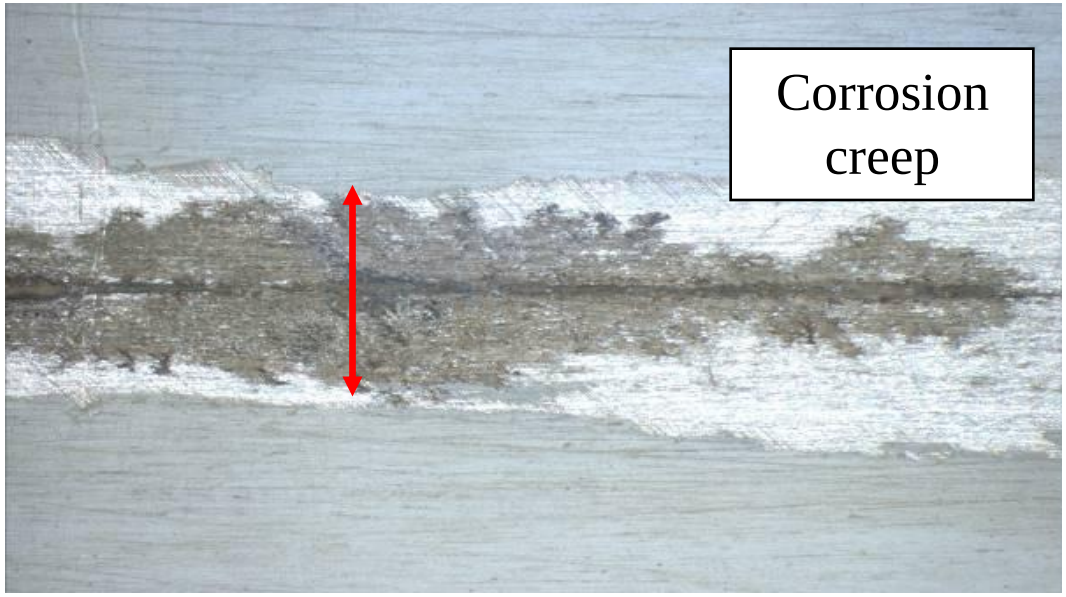
Test Matrix

	Surface treatments→ / Paints↓	A	B	C	D	E	F	G	H
		Zn phoshate	*Si*	*Zr*	*Zr*	*Zr*	*C*	*V*	*Si*
1	**Water-based 2- coat**	***A1***	B1	C1	**D1**	E1	F1	G1	H1
2	**Water-based single coat 1**	A2	B2	C2	**D2**	E2	F2	G2	H2
3	**Ecoat**	A3	B3	C3	**D3**	E3	**F3**	G3	H3
4	**Powdercoat 1**	A4	B4	C4	**D4**	E4	F4	G4	H4
5	**Powdercoat 2**	A5	B5	C5	**D5**	E5	F5	G5	H5
6	**Powdercoat 3**	A6	B6	C6	**D6**	E6	F6	G6	H6
7	**Water based 2-coat system 2**	A7	B7	C7	**D7**	E7	F7	G7	H7
8	**Water based single-coat 2**	A8	B8	C8	**D8**	E8	F8	G8	H8
9	**Water based stoving enamel**	A9	B9	C9	**D9**	**E9**	**F9**	**G9**	**H9**

3. Process selection criterea

Process Selection Criterea

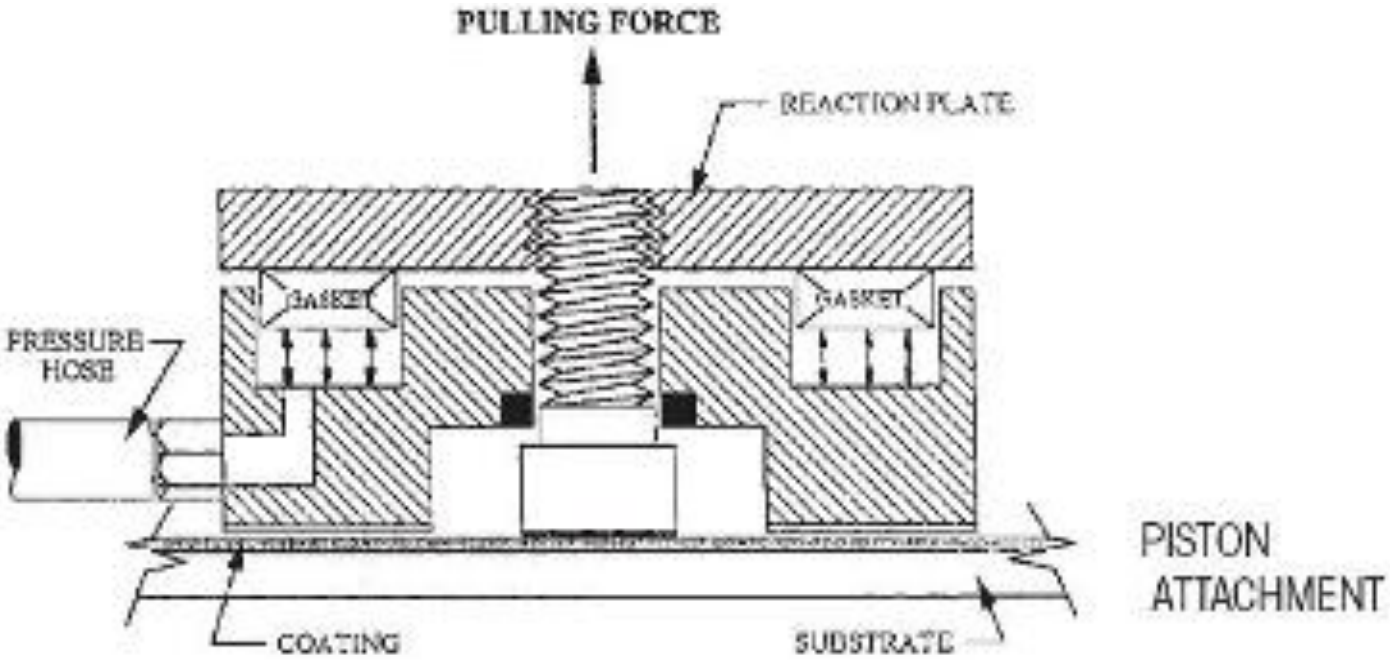
Corrosion resistance



Process Selection Criterea

Corrosion resistance

paint adhesion



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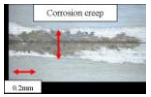
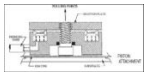


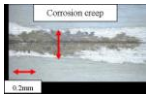
Corrosion resistance



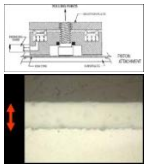
Paint adhesion

Paint thickness

Process Selection Criterea



Corrosion resistance



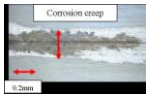
Paint adhesion

Paint thickness

Economics

$$$

Process Selection Criterea



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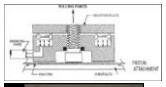


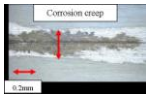
Paint adhesion

Paint thickness

Economics

Environment

Process Selection Criterea



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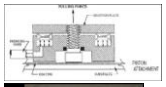


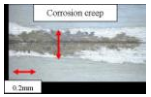
Paint adhesion

Paint thickness

Economics

Environment

Process Selection Criterea



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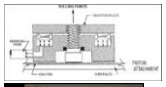


Paint adhesion

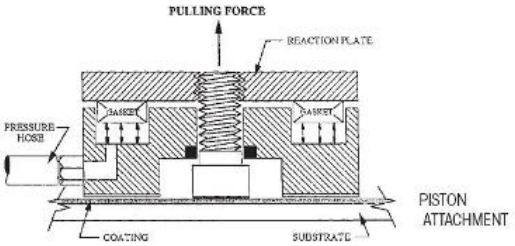
Paint thickness

Economics

Environment

Support

Process Selection Criterea



Corrosion resistance

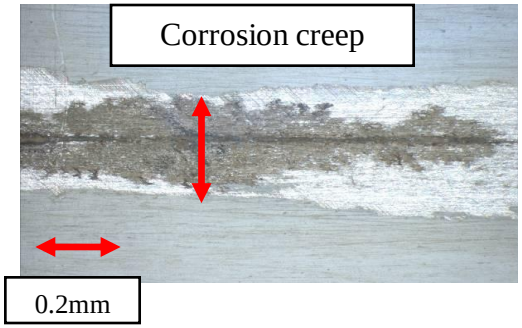
Paint adhesion

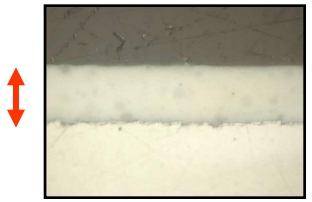
Paint thickness

Economic

Environmental

Support





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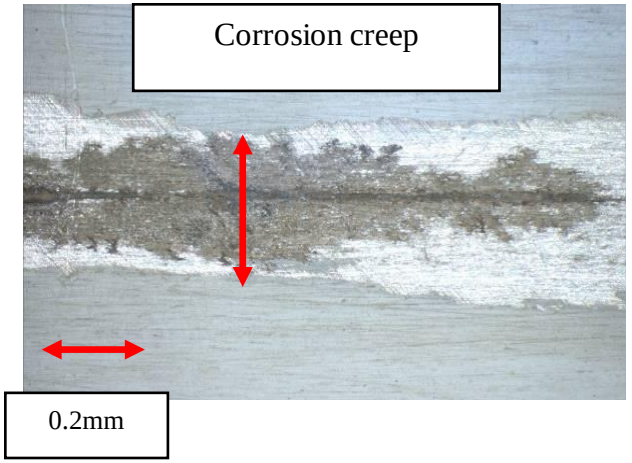
4. Assessing Performance

Corrosion

- Sample coatings were damaged (scribed X)
- Accelerated corrosion tested to ASTM B117
- After corrosion they were dried and cleaned with abrasive (scotchbrite) and examined using optical microscopy
- Measurements of the corrosion damage were made



Assessing corrosion

A3

- *Paint blistering*
- *Corrosion creep*
- *No & size of pits*

B3

C5

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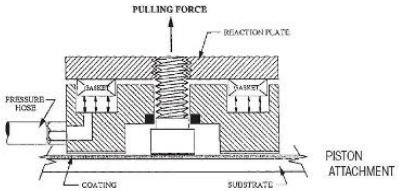
Assessment of Accelerated Corrosion Test Results

Surface treatments→ / Paints↓		A	B	C	D	E	F	G	H
		Zn phoshate	*Si*	*Zr*	*Zr*	*Zr*	*C*	*V*	*Si*
1	**Water-based 2- coat**	*A1*	B1	C1	D1	E1	F1	G1	H1
2	**Water-based single coat 1**	A2	B2	C2	D2	E2	F2	G2	H2
3	**Ecoat**	A3	B3	C3	D3	E3	F3	G3	H3
4	**Powdercoat 1**	A4	B4	C4	D4	E4	F4	G4	H4
5	**Powdercoat 2**	A5	B5	C5	D5	E5	F5	G5	H5
6	**Powdercoat 3**	A6	B6	C6	D6	E6	F6	G6	H6
7	**Water based 2-coat system 2**	A7	B7	C7	D7	E7	F7	G7	H7
8	**Water based single-coat 2**	A8	B8	C8	D8	E8	F8	G8	H8
9	**Water based stoving enamel**	A9	B9	C9	D9	E9	F9	G9	H9

Assessing Paint Adhesion



B5

A5

Assessment of Paint Adhesion

	Surface treatments→ / Paints↓	A	B	C	D	E	F	G	H
		Zn phoshate	*Si*	*Zr*	*Zr*	*Zr*	*C*	*V*	*Si*
1	**Water-based 2- coat**	adhesive	Top coat	Top coat	X	mix	pr/aq	Top Coat	mix
2	**Water-based single coat 1**	topcoat	Top coat	Top coat	X	mix	pr/aq	Top coat	mix
3	**Ecoat**	pr / phos	glue	glue	X	glue		glue	glue
4	**Powdercoat 1**	pr / phos	glue	glue	X	glue	mix	glue	glue
5	**Powdercoat 2**	200	glue	glue	X	glue	110	glue	120
6	**Powdercoat 3**	mix	glue	glue	X	glue	glue	glue	mix
7	**Water based 2-coat system 2**	pr / phos	Top coat	mix	X	Top coat	mix	Top coat	mix
8	**Water based single-coat 2**	pr / phos	glue	mix	X	mix	mix	mix	mix
9	**Water based stoving enamel**	pr / phos	mix	mix	X	X	X	X	X

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Measuring paint film thickness

B6

B4

Optical Microscope Assessment of Paint Thickness

	Surface treatments→ / Paints↓	A	B	C	D	E	F	G	H
		Zn phoshate	*Si*	*Zr*	*Zr*	*Zr*	*C*	*V*	*Si*
1	Water-based 2- coat				X				
2	Water-based single coat 1				X				
3	Ecoat				X		X		
4	Powdercoat 1				X				
5	Powdercoat 2				X				
6	Powdercoat 3				X				
7	Water based 2-coat system 2				X				
8	Water based single-coat 2				X				
9	Water based stoving enamel				X	X	X	X	X

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5. Conclusions

Overall Assessment of the Performance of New Technologies

	Surface treatments→ / Paints↓	A	B	C	D	E	F	G	H
		Zn phoshate	*Si*	*Zr*	*Zr*	*Zr*	*C*	*V*	*Si*
1	Water-based 2- coat				x				
2	Water-based single coat 1				x				
3	Ecoat				x				
4	Powdercoat 1				x				
5	Powdercoat 2				x				
6	Powdercoat 3				x				
7	Water based 2-coat system 2				x				
8	Water based single-coat 2				x				
9	Water based stoving enamel				x	x	x	x	x

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Recommendations

- The technical assessment suggests the 4 following combinations should be considered for further investigation
  - Surface treatment B & ecoat
  - Surface treatment B & powdercoat 2
  - Surface treatment E & ecoat
  - Surface treatment H & ecoat

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Thanks for listening!